

NEW *STREPTANTHUS* TAXA (CRUCIFERAE)
FROM CALIFORNIA

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ABSTRACT

Two California serpentine endemics, *Streptanthus drepanoides* Kruckeberg & Morrison, from the North Coast Ranges (Tehama to Trinity Counties) and *S. insignis* Jeps. subsp. *lyonii* Kruckeberg & Morrison from western Merced County, are described. Five new sections in *Streptanthus*, subgenus *Euclisia*, are also described.

We offer two new taxa in *Streptanthus* (Cruciferae) native to California. They are *Streptanthus drepanoides* Kruckeberg & Morrison, sp. nov. and *S. insignis* Jeps. subsp. *lyonii* Kruckeberg & Morrison, subsp. nov. Both are members of the subgenus *Euclisia*, noted for its high incidence of plants narrowly endemic to serpentine outcrops. We also give nomenclatural changes in the subgenus.

These two serpentine endemics were recognized as new by Morrison (1941) but were not published at that time. Recent study of the two enlarges our understanding of them. Several additional collections of *S. drepanoides* and periodic revisiting of the very local sites for *S. insignis* subsp. *lyonii*, combined with observations of the taxa under cultivation, their crossability with related taxa, and their chemotaxonomic profiles are the noteworthy recent contributions. These studies are part of a larger biosystematic investigation of the genus by Drs. T. Crovello, A. R. Kruckeberg, and J. Rodman. Recognition of these rare entities contributes to the inventory of rare and endemic plants of the California flora (Smith 1980).

***Streptanthus drepanoides* Kruckeberg & Morrison, sp. nov.**

Herba annua erecta glaberrima et glauca, 0.5–1.5 dm alta, simplex vel ramosa divaricata; folia orbiculata imbricata, disticha, folia radicalia petiolis brevibus, folia caulina sessilia amplexicaulia auriculata; racemi breves (4.0–8.0 cm); flores conferti; alabastra turbinata carinata saepe setis brevibus; sepala ochroleuca, apicibus erosis refractis; petala exserta, apicibus recurvatis, 0.6–0.8 cm longa, hyalina, venis unguis amplis, pari superiori curtiori quam pari inferiori; stamina paribus tres inaequalibus, pari superiori longissima (1.3 cm), exserta et

recurvata, connata usque ad antheras reductas, pari inferiori ex parte connato; stamina lateralia discreta; siliquae torulosae, arcuatae vel falcatae vel rectae, 6.0–9.0 cm longae; semina exalata vel alata vestigiale ad apicem (extremum). (Figs. 1, 2).

Annual, 0.5–1.5(–3.5) dm tall, the stem erect, simple to divaricately branched from near the base; leaves mostly basal, strongly overlapping and distichous, glabrous and glaucous, mottled gray-green, often anthocyanous beneath, succulent, entire to shallowly dentate, 2–5 cm long, 1–4 cm broad; lowermost leaves with a short broad laminate petiole, the lower cauline leaves sessile, broadly orbicular and cordate-auriculate, the upper cauline leaves broadly cordate, oblong; flowers erect in short (4.0–8.0 cm) dense, straight racemes, 0.7–0.9 cm long, the buds turbinate, carinate, and often short bristly when young; sepals ochroleucous to greenish white (or purplish), 0.5–0.65 cm long, keeled, the erose-hyaline tips reflexed, glabrous to sparingly hispidulose, the trichomes slender, simple, hyaline; petals exerted, recurved at tips, 0.6–0.85 cm long, hyaline with crisped margins and with a broad median brownish purple vein, the upper petals somewhat shorter than the lower ones, the claw 0.4 cm long and narrowly oblanceolate, the channelled blade 0.2 cm long, narrower than the claw, and undulate; stamens in three unequal pairs; upper pair of stamens markedly longer (0.75–1.3 cm long) than the other two pairs, filaments of the upper pair connate to apex and broadly veined, exerted and recurved, their sagittate anthers reduced, barely polliniferous or vestigial; filaments of the lower pair of stamens connate two-thirds of their length (0.9 cm), just exceeding the petals, the sagittate anthers polliniferous; lateral stamens free, polliniferous, approximately 0.6 cm long; siliques 5.5–9 cm long, divaricate, straight, or slightly falcate to arcuate, dense and numerous, torulose; stigma sessile; seeds wingless or with vestigial wing at one tip; cotyledons accumbent, after germination. $n = 14$ (*Kruckeberg 5901, 6627*).

TYPE: California, Tehama County, serpentine outcrops on the Paskenta-Covelo road, 12.8 km from Paskenta, 21 May 1940, *Morrison and Belshaw 3215* (Holotype: UC! UC no. 644783).

PARATYPES: California, Tehama Co., between Mud Flat and Bennett Spring, on the Newville-Covelo Rd., *Heller 11549* (WTU, UC, G, P, F, M); 8 km w. of Paskenta on the Covelo Rd. (serpentine?), *Bailey s.n.*, 16 Apr 1938 (UC); serpentine, 19.2 km w. of Paskenta on the Paskenta-Covelo Rd., 1 Sep 1966, *Kruckeberg 5903* (WTU); serpentine chaparral and Jeffrey pine woodland, along road to Wells Cr. campground ca. 1.6 km se. of Tedoc Gap, 22 Jun 1980, *Nelson and Nelson 5802* (WTU, HSC); serpentine chaparral, along Colyear Springs Rd. (25N01) 2.6 km w. of jct. with Raglin Ridge Rd. (25N01 and 25N05), 23 Jun 1970, *Nelson and Nelson 5870* (WTU, HSC). Trinity Co.: serpentine of Jeffrey pine woodland, just above Salt Cr.,

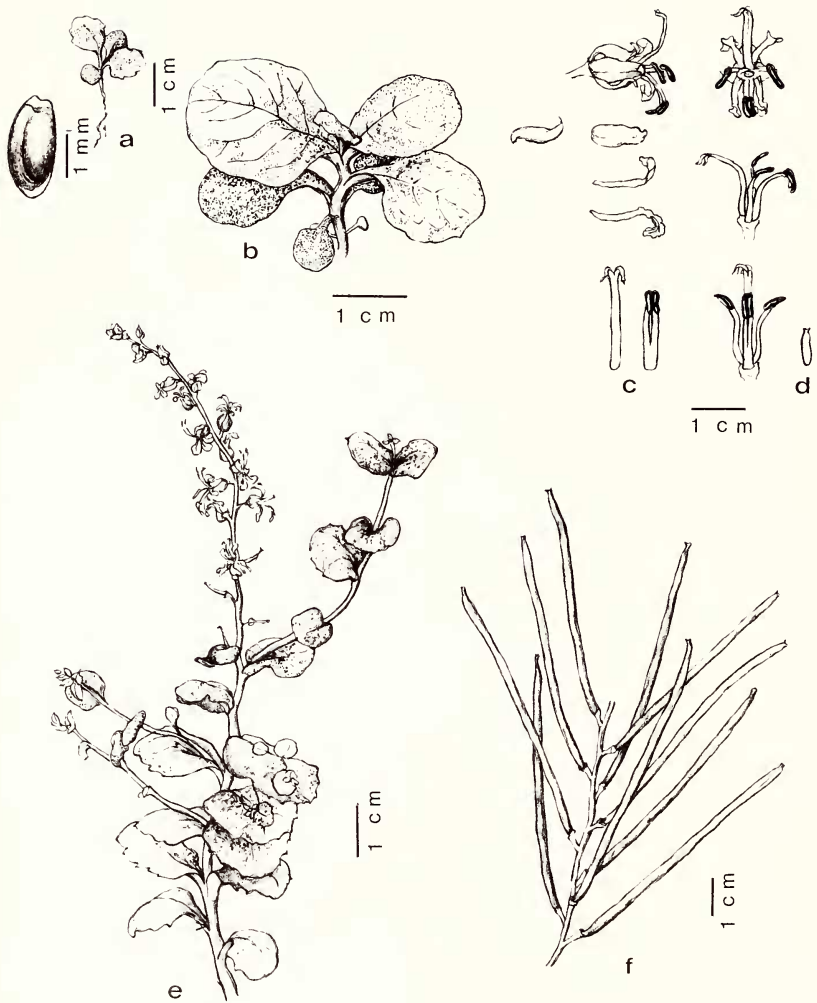


FIG. 1. *Streptanthus drepanoides*: a. Seed and seedling; b. Rosette; c. Flower (side view), sepals, upper and lower petals, sterile and fertile stamens; d. Flower (face view), androecium (2 views), pistil; e. Habit; f. Raceme with mature siliques. Drawing by Hazel Thelen from *Kruckeberg 5903*.



FIG. 2. Members of sect. *Hesperides*: a. *Streptanthus barbiger* Greene (Kruckeberg 6595); b. *S. drepanoides* (Kruckeberg 5901); c. *S. breweri* Gray (Kruckeberg 5914).

ca. 3.2 km sw. of Peanut on Highway 3, 3 Sep 1978, *Kruckeberg 6625, 6627* (WTU); serpentine barren, along road 29N28, 11.2 km s. of jct. with State Route 36 and 1.6 km from Goat Camp, 1350 m, 22 Jun 1980, *Nelson and Nelson 5744* (WTU, HSC); Jeffrey pine woodland, along Panther Camp trail 180 m n. of jct. with road 29N73, 4.8 km from Hayfork Cr., 1620 m, 22 Jun 1980, *Nelson and Nelson 5765* (WTU, HSC); serpentine, Jeffrey pine woodland, along State Route 36 on ridge between Salt Cr. and Muldoon Gulch, 4 km w. of jct. with road 30, 1290 m, 22 Jun 1980, *Nelson and Nelson 5729* (WTU, HSC); serpentine chaparral and Jeffrey pine woodland, along State Route 3, 0.5–0.8 km s. of Salt Cr. Bridge, 750 m, 19 Jun 1980, *Nelson and Nelson 5630* (WTU, HSC); serpentine chaparral and Jeffrey pine woodland, along State Route 3, 0.8 km s. of Salt Cr. Bridge, 750 m, 18 Jun 1980, *Nelson and Nelson 5547* (WTU, HSC); serpentine barrens, along Salt Cr. Rd. at junction with road 30N24, 930 m, 17 Jun 1980, *Nelson and Nelson 5502* (WTU, HSC). Shasta Co.: openings on serpentine chaparral, jct. of roads 41 and 28N08, 1200 m, 22 Jun 1980, *Nelson and Nelson 5827* (WTU, HSC); serpentine scrub and Jeffrey pine woodland, along For. Ser. Rd. ca. 1.6 km w. of Regan Meadow, 1500 m, 22 Jun 1980, *Nelson and Nelson 5839* (WTU, HSC).

Distribution. Serpentine outcrops in the inner North Coast Ranges of northwestern California; confined to western Tehama, northeastern

Mendocino, southwestern Shasta and southern Trinity Counties. *Streptanthus drepanoides* grows in open serpentine chaparral, and open Jeffrey pine and digger pine woodlands, especially in intervening barren serpentine rubble. It is also locally common on serpentine road-cuts: 610 to 1635 m.

The strongly two-ranked (distichous) lower leaves, broadly orbicular in outline, the erect, short congested inflorescence and the falciform siliques set *S. drepanoides* apart from its nearest relatives. It clearly shows close affinity to members of the *Hesperides* section of subgenus *Euclisia*, particularly to *S. breweri* Gray and *S. hesperidis* Jepson. Specimens of *S. drepanoides* have been filed in herbaria as *S. hesperidis*. It can be distinguished readily from these congeners by vegetative, floral, and fruit characters (Table 1).

Streptanthus drepanoides, endemic to serpentine, has been collected with increasing frequency in recent years. Besides our own collections, those of Thomas and Jane Nelson (Humboldt State University, Arcata, CA), extend the range from the type locality north and west into eastern Mendocino, Shasta, and Trinity Counties. The Nelsons' collections from the Mt. Lassic massif of southwestern Trinity County and both theirs and ours from near Peanut, Trinity County, definitely show the species to be more centrally located north of the type locality. At the latter station, *S. drepanoides* is associated with serpentine chaparral: low statured *Quercus durata* with *Arctostaphylos* and *Garrya*, and widely scattered *Pinus sabiniana*. In Trinity County, plants of *S. drepanoides* frequently occur on serpentine slopes and openings in Jeffrey pine parkland, with *Rhamnus californica* var. *crassifolia* and *Arctostaphylos stanfordiana*. It coexists here on serpentine with *S. tortuosus* Kell. and the Trinity County serpentine endemic, *S. barbatus* Wats.

Streptanthus drepanoides is the northernmost member of the section *Hesperides* (subgenus *Euclisia*). The inner Coast Range taxa of this group appear to replace one another from south to north. Although *S. breweri* and *S. hesperidis* can be locally sympatric in Lake County, we have found no case in which *S. drepanoides* coexists with other members of the section. Instead, it can be found growing with members of two other groups, as mentioned above.

Streptanthus drepanoides is diploid ($n = 14$), as are all members of the section *Hesperides*. Artificial crosses with *S. breweri* and *S. hesperidis* have reduced fertility (0–50% pollen stainability).

The specific epithet refers to the sickle-shaped siliques.

***Streptanthus insignis* Jepson subsp. *lyonii* Kruckeberg & Morrison, subsp. nov.**

Herba annua hispidissima, erecta, simplex vel pauciramosa vel multiramosa, 1.0–3.5 dm alta; folia a var. *insignis* optime congruentia,

TABLE 1. COMPARISON OF *S. drepanoides* TO OTHER TAXA OF SECT. *Hesperides*.

	<i>S. drepanoides</i>	<i>S. breweri</i>	<i>S. hesperidis</i>
Habit	low (0.5-1.5 dm), simple to branched	tall (1.5-5.0 dm), usually much branched	intermediate (1.0-1.5 dm), simple
Plant color	gray-green	bluish green	yellow-green
Leaf arrangement	congested, distichous	openly spaced; spiral	openly spaced; spiral
Basal and cauline leaves	orbicular, obscurely toothed or entire, margin revolute	ovate, shallowly toothed; margin plane	obovate-lanceolate, deeply toothed; margin plane
Inflorescence	straight, erect, congested, mostly unbranched	erect to divaricate; open, elongate, amply branched	zig-zag in outline, short, erect, mostly unbranched
Flower color	ochroleucous	rose-purple or white	ochroleucous
Flower	small; constricted at throat	larger; open at throat (anthesis)	small; constricted at throat
Siliques	erect or divaricate, falcate	strongly recurved	erect to divaricate, straight
Habitat	serpentine chaparral, Jeffrey pine woodlands	serpentine chaparral or barrens	serpentine chaparral or barrens
Range	Tehama, Shasta and Trinity Counties	San Benito to Colusa Counties	Napa, Lake Counties

sed hispidiora; flores fertiles lutescentes, sed flores in fasciculis terminalibus conferti, melanopurpurei vel lutescentes; stamina et siliquae a var. *insignis* optime congruentia.

Annual, with the habit and vegetative features of subsp. *insignis*, densely hispid throughout, erect, simple or usually much branched, compact, 10–35 cm tall; basal and lower cauline leaves linear-lanceolate, pinnatifid, the teeth tipped with callosities, calyx greenish-yellow, the petals lemon-yellow or yellowish-white, much exerted, crisped, obtuse; flowers often secund, abundant; terminal cluster of sterile flowers (“color spot”) purplish black or pale yellow; stamens in three unequal sets, the upper set with filaments connate to the reduced anthers, exerted, the lower set shorter and less connate, the lateral set with filaments free, approximate, and short; silique narrow, often sharply deflexed, copiously hispid with flavescent setae; seeds winged; cotyledons accumbent. $n = 14$.

TYPE: California, Merced County, serpentine outcrop, 2 mi n. of Ortigalita Peak, inner South Coast ranges, 3 Apr 1938, *Lyon 1223* (Holotype, UC!).

PARATYPES: California, Merced Co., 4 May 1940, *Morrison 3127* (UC!); on steep, w.-facing serpentine slope, just e. of road above and ne. of Wiseman Flats, 535 m, 24 Aug 1978, *Kruckeberg 6578* (WTU, type locality); on steep, w.-facing chert-shale slopes just n. of ridge between Wiseman Flats and Piedra Azul Springs, ca. 0.5 km n. of type locality, 540 m, 24 Aug 1978, *Kruckeberg 6581* (WTU), the “bicolor” form.

Distribution. Restricted to western Merced County, subsp. *lyonii* is locally frequent, mostly on serpentine of low hills at east base of inner South Coast Ranges between Wiseman Flats and Piedra Azul Spring, Arburua Ranch, T13S R9E51, (Mt. Diablo Base Meridian), ca. 600 m. The habitat is mostly annual grassland with a rich forb cover. Widely spaced blue oaks (*Quercus douglasii*) are in the vicinity; occasional plants of *Juniperus californica* and *Artemisia californica* occur adjacent to the serpentine outcrop of the wholly yellow-flowered form. The variant with yellow flowers and a purple terminal “color spot” grows on a chert-shale slope (*Kruckeberg 6578*). It is probable that other localities exist along the lower stretches of Piedra Azul Creek and nearby lower slopes of the range, just to the north of Ortigalita Peak. Associated species on serpentine (*Kruckeberg 6578*) include *Eriogonum inflatum*, *Eschscholtzia lemmonii*, *Bromus rubens*, *Camissonia refracta*, *Emmenanthe penduliflora*, *Phacelia fremontii*, *P. distans*, *Cryptantha* sp., *Malacothrix obtusa*, *Chaenactis glabriuscula* (or *C. fremontii*), *Salvia columbariae*, and *Silene multinervia*. On the non-serpentine site just south of Piedra Azul Spring associates were *Eriogonum fasciculatum*, *Calochortus venustus* (?), *Trifolium* (large

annual species), *Chorizanthe membranacea*, *Lupinus* (annual species), *Avena fatua*, *Bromus rubens* and *B. mollis*.

Apart from the collections by Gregory Lyon and John Morrison in the 1930s, this rare and local variant remained little known until the 1970s, when it was revisited by Lyon and Morrison, and then in 1978 by Lyon and Kruckeberg (*Kruckeberg 6578, 6581*). Subspecies *lyonii* is just to the east of the main range of *Streptanthus insignis* subsp. *insignis*; the typical form occurs on serpentine along the western flank of the Inner South Coast Ranges from New Idria north to Panoche Pass, and is thus more widespread than subsp. *lyonii*. The members of section *Insignes* are all confined to the Diablo Range and thus form a geographically coherent group. *Streptanthus hispidus* Gray, endemic to non-serpentine sites on Mt. Diablo (Contra Costa Co.), is the northernmost species. Proceeding southward, the extremely rare *S. callistus* Morrison is known from only one non-serpentine chaparral hillside just east of Mt. Hamilton. *Streptanthus insignis* subsp. *insignis* and subsp. *lyonii* are the southernmost taxa of the group, confined to southwestern Merced, southeastern San Benito, and eastern Monterey Counties (and possibly southwestern Fresno County).

Although subsp. *insignis* is rather uniform in character, with purplish white flowers and a purple-black "color spot" terminating the inflorescence, subsp. *lyonii* in flower has two distinct variants. The serpentine locality at Wiseman Flats has plants with wholly lemon yellow inflorescences (*Kruckeberg 6578*), whereas the non-serpentine plants near Piedra Azul Spring (*Kruckeberg 6581*) have yellow flowers below the terminal purple-black cluster (the "color spot"). Morrison (1941) in his unpublished thesis gave this latter variant the name "bicolor." Subsequent greenhouse observations and crosses between the two suggest the recognition of the two variants as one subspecies. Another taxonomic solution would be to recognize two varieties under subsp. *lyonii*. The serpentine plants would be "var. *lyonii*" and the non-serpentine "bicolor" plants "var. *bicolor*." We refrain from taking this step at this time.

Besides flower color, other features serve to distinguish subsp. *insignis* from subsp. *lyonii*. The latter is much more hispid throughout the entire plant than is subsp. *insignis*; particularly notable are the short, stiff setae copiously clothing the ovary and the mature silique.

Gregory Lyon, then of Firebaugh, California, discovered this unique variant of *S. insignis* in 1938 in the course of his many seasons of botanizing this little known sector of the South Coast Ranges. Often with the authors, Lyon then revisited the localities over the years, providing a faithful record of its occurrences, in good years and bad. In manuscript, Morrison (1941) proposed the name of *S. lyonii*, which we now happily formalize in print as subsp. *lyonii*.

All members of sect. *Insignes* are diploid ($n = 14$), and all but *S.*

TABLE 2. CROSSES AMONG SOME MEMBERS OF *Streptanthus* SECTION *Insignes*.

Cross	Features	Pollen stainability	Seed set
<i>lyonii</i> × <i>lyonii</i> (<i>Kruckeberg</i> 6578 × 6581)	Intermediate to variable; calyces yellow green, green, or green suffused with purple; petals dull white; terminal "color spot" with tips of calyces barely colored to colored ¼ way from tip. Copious pollen; normal siliques.	>95% (4)	high
<i>lyonii</i> × <i>insignis</i> (<i>Kruckeberg</i> 6581 × 6574)	Intermediate; calyces pale green to ochroleucous; "color spot" variable	>95% (2)	high
<i>lyonii</i> × <i>callistus</i> (<i>Kruckeberg</i> 6581 × 6590)	Hybrids like ♂ parent but with paler flowers	0, 25, 50–75% (4)	high
<i>insignis</i> × <i>lyonii</i> (<i>Kruckeberg</i> 6574 × 6578)	Intermediate; greenish-yellow calyces; white-tipped petals with purple veins	>95%	high
<i>insignis</i> × <i>callistus</i> (<i>Kruckeberg</i> 6574, 6031a × 6590)	Flowers and habit intermediate	>50% (few grains)	high
[<i>insignis</i> (6031a) × <i>hispidus</i> (6025)—no hybrid plants]			

hispidus can be intercrossed to yield hybrid plants. The crosses between *S. insignis* subsp. *insignis* and subsp. *lyonii* have good pollen (>95% stainable), set viable seed on selfing, and show a range of parental characters in the F₁ plants. Intentional hybrids between both subspecies of *S. insignis* and *S. callistus* have reduced fertility (0–50% stainable pollen), are either good intermediates or favor *S. callistus* in character, and have set some seed on backcrossing and selfing. Meiotic behavior of the hybrids is normal (Table 2). These crossing results then support the subspecific status of *lyonii* within *S. insignis* and further highlight the species level discontinuity between *S. insignis* and *S. callistus*. Even though no viable hybrids have been obtained using *S. hispidus* as a male or female parent, the features of this species clearly align it with the other *Insignes* taxa. (See Fig. 3.)

Rodman et al. (1981) have compiled 27 seed glucosinolate characters from most of the taxa (39) in *Streptanthus*. Their summary diagram (fig. 2, Rodman et al. 1981, listed as "drepanoides" and "lyoni") includes the two new taxa described here. *Streptanthus drepanoides* is well separated (distance coefficient of 0.3) from the other taxa of sect. *Hesperides* that were tested (*S. barbiger* Greene and *S. breweri*). The two subspecies of *S. insignis* proved to have close chemical affinities



FIG. 3. Members of sect. *Insignes*: a. *Streptanthus hispidus* Gray (Kruckeberg 6025); b. *S. insignis* subsp. *lyonii* (Kruckeberg 6581); c. *S. insignis* subsp. *insignis* (Kruckeberg 6574).

(distance coefficient of 0.1). The distance coefficient between the subspecies of *S. insignis* and *S. hispidus* is 0.2; in fact, *S. insignis* has closer chemical affinity with other taxa outside of its section than it does with *S. hispidus*, here placed in sect. *Insignes*.

Both *S. drepanoides* and *S. insignis* should be considered rare and perhaps endangered. We suggest that they be given formal status in the Inventory of Rare and Endangered Vascular Plants of California (Smith et al. 1980). *Streptanthus drepanoides* and *S. insignis* subsp. *insignis* could be assigned to List 3—Plants Rare but not Endangered; *S. insignis* subsp. *lyonii* seems appropriate for List 2—Plants Rare and Endangered. *Streptanthus callistus* and *S. hispidus* are already on List 2 of this inventory.

SECTIONAL TAXONOMY

Five new sections for subgenus *Euclisia*. The subgenus *Euclisia* Nutt. ex T. & G. of *Streptanthus*, to which these new taxa belong, has five clearly definable subgroups. We wish to recognize them formally as sections here. Biosystematic studies to support these sections are in progress; a monograph of subgenus *Euclisia* will be one facet of the work. The junior author, Morrison (1941), recognized in manuscript four sections of subgenus *Euclisia*. An additional section is pro-

posed here, on the basis of the discovery of distinctive biennials with euclisian affinities by Hoffman (1952). The five sections are: *Euclisia*, *Insignes*, *Hesperides*, *Biennes*, and *Polygaloides*. Earlier treatments of the the subgenus *Euclisia* Nutt. are found in Jepson (1925, 1936), Morrison (1941) and Hoffman (1952). The earliest application of *Euclisia* was by Torrey and Gray (1838); they used the epithet as one of two subdivisions of *Streptanthus* Nutt. The name *Euclisia* (spelled *Euklisia* by Torrey and Gray) embraced six of the 12 taxa in *Streptanthus* known at that time. Plants of their concept of euclisian affinity were characterized by Torrey and Gray as having "petals narrow; calyx closed." They give the epithet as "*Euklisia*, Nutt., mss." All subsequent authors have cited the taxon as *Euclisia* (or *Euklisia*) Nutt., but in fact it should be rendered *Euclisia* Nutt. ex Torrey and Gray. As construed by Nuttall and Torrey and Gray, *Euclisia* included a heterogeneous set of species.

E. L. Greene (1904) first redefined the limits of *Euclisia* as a genus and specified the taxa referred to it. Then Jepson (1925, 1936) treated the group as subgenus *Euclisia* of the genus *Streptanthus*. Morrison (1941), Hoffman (1952), and the present authors have followed Jepson's circumscription of the subgenus. The salient features of subgenus *Euclisia* include zygomorphic flowers, non-bracteate inflorescences, filaments of one or two pairs of stamens partially to completely connate, and the upper pair of stamens usually with reduced to vestigial (and sterile) anthers. While no one of these features is unique to *Euclisia*, the consistent co-occurrence of them distinguishes the group from other subgenera of *Streptanthus*. Furthermore the great majority of euclisian taxa are partially to obligately serpentinicolous, often narrowly endemic to serpentinities.

Subgenus *Euclisia* Nutt. ex. Torr. & Gray, Fl. N. A. 1:77. 1838.

STREPTANTHUS Section EUCLISIA.

Annuals, usually with hispid stems and leaves, base of setae on leaves pustulate; basal leaves 5–10 cm long, hispid (except *S. niger* and *S. albidus* subsp. *albidus*), narrowly lanceolate, coarsely and sinuately toothed to shallowly pinnatifid, the teeth callus-tipped; cauline leaves sessile, auriculate-clasping, narrowly lanceolate, remotely toothed, gradually reduced upwards, there becoming entire, auriculate, lanceolate, and acuminate. Flowers in open simple or branched ebracteate racemes; calyx zygomorphic, inflated and umbilicate, red, purple, lilac or ochroleucous to yellow or white, sepals carinate; petals unequal, usually strongly recurved, red, purple or white; stamens in 3 unequal pairs, the upper with connate filaments; stigma flat, round; siliques flattened, glabrous or hispid; seeds winged; cotyledons accumbent.

TYPE SPECIES. *S. glandulosus* Hook., Ic. Pl. 1, pl. 40. 1836.

Distribution. Cismontane California, west of the Great Valley from San Luis Obispo County to northwestern California (and southwestern Oregon); usually on serpentine.

This section is typified by *S. glandulosus* Hook., the most variable and the widest ranging species in subgenus *Euclisia*. It includes, besides *S. glandulosus*, *S. niger* Greene and *S. albidus* Greene. These species and their infraspecific taxa have been treated elsewhere (Kruckeberg 1958).

Streptanthus Section **Insignes** Kruckeberg & Morrison, sect. nov.

Herbae annuae hispidissimae; inflorescentia fasciculibus terminalibus confertibus florum sterilium laete colorum; siliquae hispidae, planae vel teretae; semina alata vel exalata, plana vel rotunda.

Densely hispid, mostly low, compact annuals; inflorescence usually simple, compact, with a terminal "color spot" composed of sterile calyces much elongated, highly colored, mostly purplish black (or yellow); sepals purple or greenish yellow; petals purplish white to red, or flavescent, narrow, channeled, the blade margin crisped, the claw broad, yellowish; stamens in three unequal sets, the filaments of the upper and lower sets connate; siliques flattened or terete, erect or spreading or deflexed, hispid; stigma two-lobed; seeds winged or wingless, flattened or rounded; cotyledons accumbent.

TYPE SPECIES. *Streptanthus insignis* Jepson, Man. Fl. Pl. Calif. 420. 1925.

Section *Insignes* consists of three disjunct species, *S. hispidus* Gray, *S. callistus* Morrison and *S. insignis* (with two subspecies *insignis* and *lyonii*). They are confined to the inner South Coast Ranges of California (the Diablo Range), from Mt. Diablo in Contra Costa County to the New Idria country of San Benito County. Habitat, distribution, interfertility, and other attributes have been given in an earlier section of this paper. Figure 3 shows three *Insignes* taxa.

Streptanthus Section **Hesperides** Kruckeberg & Morrison, sect. nov.

Herbae annuae glabrae et glaucae; folia radicalia petiolata, ovata vel lanceolata, dentata; flores irregulares (zygomorphi), purpurei, viridio-albidi vel lutei; sepala carinata, glabra vel parce setosa; petala paribus inaequalibus, recurvata, purpurascencia vel albida; stamina paribus tres inaequalibus, pari superiori connata, antheris sterilibus, pari inferiori saepe ex parte connata; siliquae graciles, planae, reflexae, arcuatae vel divaricatae vel erectae; semina plerumque exalata.

Annuals, entire plant glabrous, glaucous, semi-succulent; basal leaves petiolate, ovate, deltoid to lanceolate, broad to narrow, usually coarsely toothed, the cauline leaves sessile, auriculate-clasping, toothed to entire; calyx flask-shaped in bud, purple, greenish-white or yellow,

glabrous or rarely slightly setose-pubescent, slightly irregular, prominently keeled; petals purple or yellowish white, in two unequal sets, narrow, channeled, recurved, the blade scarcely broader than the claw, slightly crisped; stamens in three unequal pairs, the filaments of the upper pair wholly connate with sterile anthers, the filaments of the lower pair often partly connate; silique slender, flat, slightly torulose, erect to curved, spreading or deflexed; seeds slightly winged or wingless; cotyledons accumbent. Figure 2 shows three *Hesperides* taxa.

TYPE SPECIES: *Streptanthus breweri* Gray, Proc. Amer. Acad. 6: 184. 1864.

Section *Hesperides* contains five species, all restricted to serpentine soil; they are *S. breweri* Gray, *S. barbiger* Greene, *S. hesperidis* Jepson, *S. batrachopus* Morrison and *S. drepanoides* Kruckeberg & Morrison. The range, habitat and other attributes of the species are to be found within the discussion of the new species, *S. drepanoides*, given in this paper.

Streptanthus section **Biennes** Kruckeberg & Morrison, sect. nov.

Herbae biennes glabrae et glaucae, humiles (2.0 dm) vel altae (7.5–12.5 dm); folia radicalia juvenilia petiolata, spathulata dentata; flores irregulares, in racemis vel paniculis amplis ramosis; calyces ampulliformes, glabri vel setosi, lutei vel purpurei, tres paribus inaequalibus, pari superiori connata recurvata, sterili, inferiori ex parte connata, reflexa; siliquae torulosae, erectae vel deflexae; semina fere exalata.

Glaucous and glabrous biennials, low (20 cm) to tall (75–125 cm), the first year rosettes of petiolate, broadly spatulate and coarsely dentate leaves; flowers in openly branched racemes or panicles, zygomorphic; calyx flask-shaped; sepals glabrous or setose, yellow to purple, carinate; petals white to salmon-colored, crisped, unequal, recurved; stamens in 3 unequal pairs, the upper with connate filaments, strongly recurved upward, the lower set partially connate and recurved downwards; siliques erect, divaricate or reflexed, usually torulose; seeds only weakly winged at tip; cotyledons accumbent.

TYPE SPECIES: *Streptanthus morrisonii* F. Hoffman, Madroño 11: 225. 1952.

Section *Biennes*, with at least two species [*S. morrisonii* Hoffman and *S. brachiatus* Hoffman (Hoffman 1952)] is wholly serpentinicolous and restricted to Sonoma and Lake Counties of central California. Recent studies (Dr. J. A. Neilson, unpubl.) made in connection with environmental impact surveys of geothermal power sites in the vicinity of these endemics, suggest the presence of considerable interpopulational variation in *S. brachiatus*. Hoffman's (1952) taxonomy of this remarkable and polymorphic group may have to be modified.

Streptanthus Section **Polygaloides** Kruckeberg & Morrison, sect. nov.

Herbae annuae graciles et glaucae, folia flavo-virescentia, linearia, inferioria grosse pinnata, caulinia integra, filiforma; florum valde zygomorphae et appanatae, luteae vel purpureae; sepala superiora ampla, scutiforma exteriora, sepala lateralia et abaxialia interiora; petala brevia exserta, fere aequalia; stamina inaequalia tres paribus, pari superiori late connata, antheribus sterilibus; semina exalata.

Slender, erect, branched annuals, glabrous throughout; leaves yellow-green, linear-filiform, the lower coarsely pinnate, the upper entire; inflorescence of open to erect and branched racemes; flowers very zygomorphic, strongly dorsiventrally flattened, yellow or purple, the upper sepal broad, banner-like, cuneate-truncate, overlapping the two smaller lateral and one abaxial sepals; petals shortly exerted, pale yellow to white, crisped, nearly equal in shape; stamens in 3 pairs, the upper with broad, bright green, connate filaments, tipped with tiny aborted anthers, the other pairs not connate; siliques short, flat, arcuately reflexed; seeds not winged; cotyledons accumbent.

TYPE SPECIES. *Streptanthus polygaloides* Gray, Proc. Amer. Acad. 6:519. 1865.

Section *Polygaloides* is monotypic, with a species whose *Polygala*-like flowers are strikingly deviant from any other California crucifer. With perhaps good cause, E. L. Greene (1904) proposed the genus *Microsemia* [*M. polygaloides* (Gray) Greene] for this remarkable plant. The idea that the species may be generically monotypic has been revived recently by the finding (Reeves et al. 1981) that it is a "hyperaccumulator" (>1000 ppm) of nickel, a heavy metal often associated with serpentine soils. Other serpentine species of *Streptanthus* did not show the high levels of nickel (3300–14,800 ppm) that point to *S. polygaloides* as the first hyperaccumulator found in North America.

However, features of foliage and details of flower and fruit mark its affinity with other euclisian species, though *S. polygaloides* does share some attributes with *S. tortuosus* Kell. and *S. diversifolius* Wats. of subgenus *Pleiocardia*. This monotypic section is wholly confined to the serpentines of the Sierra Nevada foothills from Mariposa to Butte Counties, California.

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Note added in proof: The range of *S. drepanoides* must now include Butte County, in the western Sierra Nevada. R. E. Preston, of Chico State University, collected it on a s.-facing serpentine slope, along the w. branch Feather River fork of Lake Oroville, ca. 1.1 km ese. of Kunkle Reservoir, ca. 7.2 km se. of Paradise, Butte County, California (T21NR4E, ne. ¼ ne. ¼ S6, Cherokee 7½' quad), at 278 m. Plants grown from seed of this collection (Preston 293) are confirmed by the senior author to be *S. drepanoides*. Until this recent find, all members of Sect. *Hesperides* (subgenus *Euclisia*) were known only from the Coast Ranges.